

## IN THE CLAIMS

1           1. [currently amended] A process comprising:  
2           validating a ~~formal language specification~~ Formal Language Specification written  
3           in a formal language which has predetermined rules of syntax and semantics, said ~~formal~~  
4           ~~language specification~~ Formal Language Specification defining a computer program to be  
5           automatically written;  
6           automatically translating each element of a ~~formal language specification~~ Formal  
7           Language Specification defining an object model, a functional model, a dynamic model  
8           and a presentation model, which taken together define the requirements of the program  
9           to be automatically written, into a full and complete computer program which needs no  
10          additional third party source code or source code from existing components or code  
11          libraries to be compiled with it to make said computer program complete and which  
12          implements the requirements of said ~~formal language specification~~ Formal Language  
13          Specification, said ~~formal language specification~~ Formal Language Specification defining  
14          at least an identification function for every class, and at least a valuation for every  
15          variable attribute, said translating step comprising the following steps:  
16                  using a computer, automatically write computer code that will request user  
17                  name and password, receive any responses and authenticate the user;  
18                  using a computer, automatically write computer code that has the  
19                  capability to control a computer to provide a mechanism to will determine a this  
20                  user's privilege level from log in information supplied by said user which identifies  
21                  said user and query said ~~formal language specification~~ Formal Language  
22                  Specification and determine all object attributes said user has privilege to see and  
23                  all services said user has privileges to can invoke;  
24                  using a computer, automatically write computer code which has the  
25                  capability to query queries said ~~formal language specification~~ Formal Language  
26                  Specification for all services of all classes that any authorized user has privileges  
27                  to may invoke and identify ~~identifies~~ an object server which will implement each  
28                  said service;  
29                  using a computer, automatically write code that has the capability to will  
30                  retrieve service arguments for all services;  
31                  using a computer, automatically write code that is capable of controlling  
32                  ~~controls~~ a computer to provide a display means by which an entity has a

33 ~~mechanism to and entity can~~ invoke a service, and which has a mechanism to  
 34 ~~receive receives~~ input to invoke a particular service and ~~respond responds~~ by  
 35 sending a message to the appropriate object server to invoke the service, said  
 36 message including the ~~necessary~~ arguments required for the service to execute;

37 using a computer, automatically write code that has the capability to  
 38 control a computer to implement ~~implements~~ an object server for every service,  
 39 each of which first checks to verify that state transitions are valid ~~and make~~  
 40 ~~sense~~ for the current state of objects of which the object server will be altering  
 41 the state;

42 using a computer, automatically write code that has the capability to  
 43 control a computer to implement ~~for~~ every object server that verifies preconditions  
 44 are satisfied before making state transitions of any objects the states of which  
 45 are acted upon by the object server;

46 using a computer, automatically write code that has the capability to  
 47 control a computer to make all valuation calculations required by said ~~formal~~  
 48 ~~language specification~~ Formal Language Specification of each object server;

49 using a computer, automatically write code that has the capability to  
 50 control a computer to verify that integrity constraints specified in said ~~formal~~  
 51 ~~language specification~~ Formal Language Specification on the values of attributes  
 52 of objects have been satisfied after execution of a service and respond by  
 53 reversing any changes in state which caused said integrity constraint to be  
 54 violated ~~take action~~ if said integrity constraints are not satisfied; and

55 using a computer, automatically write code that has the capability to  
 56 control a computer to implement ~~for~~ every object server such that said object  
 57 server tests to test trigger relationships specified in said ~~formal language~~  
 58 ~~specification~~ Formal Language Specification after execution of a service and  
 59 invoke a predetermined service associated with a trigger event ~~carry out~~  
 60 ~~appropriate action~~ if said a trigger event has occurred.

1 2. [currently amended] An apparatus for automatically translating a ~~formal~~  
 2 ~~language specification~~ Formal Language Specification defining an object model, a  
 3 functional model, a dynamic model and a presentation model, which taken together define  
 4 the requirements of a computer program to be automatically written, said ~~formal language~~

5 ~~specification~~Formal Language Specification being written in a formal language which has  
 6 predefined rules of grammar, said translating acting to convert said ~~formal language~~  
 7 ~~specification~~Formal Language Specification into a computer program that implements the  
 8 requirements of said ~~formal language specification~~Formal Language Specification, said  
 9 ~~formal language specification~~Formal Language Specification defining at least an  
 10 identification function for every class and at least a valuation for every variable attribute,  
 11 said apparatus comprising:

12 a computer programmed with an operating system and one or more other  
 13 programs to cooperate with said operating system to control said computer to perform  
 14 the following functions:

15 A) using said predetermined rules of grammar to validate said ~~formal~~  
 16 ~~language specification~~Formal Language Specification to ensure that said ~~formal~~  
 17 ~~language specification~~Formal Language Specification is complete and correct;

18 B) automatically write computer code that will request user name and  
 19 password, receive any responses and authenticate the user;

20 C) automatically write computer code that will determine a user's privilege  
 21 level for a user identified by user name and password entered in response to the  
 22 query caused by the code written in step B, and query said formal specification  
 23 and determine all object attributes said user has privilege to see and query and all  
 24 services said user has privileges to can-invoke;

25 D) automatically write computer code which queries said formal  
 26 specification for all services of all classes that any authorized user has privileges  
 27 to may-invoke and identifies an object server which will implement said service;

28 E) automatically write code that will retrieve service arguments for all  
 29 services;

30 F) automatically write code that displays one or more user interface tools  
 31 which provide a mechanism can be used to invoke a service, and which provides  
 32 a mechanism to receive receives input to invoke a particular service and which  
 33 responds by sending a message to the appropriate object server to invoke said  
 34 service, said message including the ~~necessary~~ arguments required for said  
 35 service to execute;

36 G) automatically write code that implements an object server for every  
 37 service, each of which first checks to verify that state transitions are valid ~~and~~

38 ~~make sense~~ for the current state of objects the object service will be altering the  
 39 state of;

40 H) automatically write code for every object server that verifies  
 41 preconditions are satisfied before making state transitions of any objects the  
 42 states of which are acted upon by said object server;

43 I) automatically write code to make all valuation calculations required by  
 44 said specification of each object server;

45 J) automatically write code to verify that integrity constraints specified in  
 46 said Formal Language Specification ~~formal specification~~ on the values of  
 47 attributes of objects have been satisfied after execution of a service and  
 48 reversing any changes in state which caused said integrity constraints to be not  
 49 satisfied ~~take action~~ if said integrity constraints are not satisfied; and

50 K) automatically write code for every object server to test trigger  
 51 relationships specified in said Formal Language Specification ~~formal specification~~  
 52 after execution of a service and invoke a predetermined service associated with  
 53 a trigger event ~~carry out appropriate action~~ if a trigger event has occurred.

1 3. [currently amended] A physical computer-readable storage media ~~medium~~  
 2 containing instructions for controlling a computer to automatically translate a ~~formal~~  
 3 ~~language specification~~ Formal Language Specification defining an object model, a  
 4 functional model, a dynamic model and a presentation model, which taken together define  
 5 the requirements of a computer program to be automatically written, said ~~formal language~~  
 6 ~~specification~~ Formal Language Specification defining at least an identification function for  
 7 every class and at least a valuation for every variable attribute said ~~formal language~~  
 8 ~~specification~~ Formal Language Specification written in a formal language having  
 9 predefined rules of grammar, by:

10 validating a ~~formal language specification~~ Formal Language Specification written in  
 11 a formal language which has predetermined rules of syntax and semantics, said  
 12 validating accomplished using said predetermined rules of syntax and semantics to  
 13 ensure said ~~formal language specification~~ Formal Language Specification is complete and  
 14 correct;

15 automatically writing computer code that will request user name and password,  
 16 receive any responses and authenticate the user;

17 automatically writing computer code that will determine a user's privilege level and  
 18 query said Formal Language Specification ~~formal-specification~~ and determine all object  
 19 attributes said user has privilege to see and all services said user has privileges to can  
 20 invoke;

21 automatically writing computer code which queries said Formal Language  
 22 Specification ~~formal-specification~~ for all services of all classes that any authorized user  
 23 has privileges to may-invoke and identifies an object server which will implement said  
 24 service;

25 automatically writing computer code that will retrieve service arguments for all  
 26 services;

27 automatically write code that displays menus options, icons or creates any other  
 28 means or mechanism through ~~by~~ which a user or another process has the capability to  
 29 ~~can~~ invoke a service, and which provides a mechanism through which ~~receives~~ input to  
 30 invoke a particular service is provided and mechanisms to provide values for arguments  
 31 is provided and a mechanism is provided to construct and send ~~responds by sending a~~  
 32 message to the appropriate object server to invoke the service, said message including  
 33 the ~~necessary~~ arguments required for the service to execute;

34 automatically writing code that implements an object server for every service,  
 35 each of which first checks to verify that state transitions are valid ~~and make sense~~ for  
 36 the current state of objects the object service will be altering the state of;

37 automatically write code for every object server that verifies preconditions are  
 38 satisfied before making state transitions of any objects the states of which are acted  
 39 upon by the object server;

40 automatically write code to make all valuation calculations required by said Formal  
 41 Language Specification ~~formal-specification~~ of each object server;

42 automatically write code to verify that integrity constraints specified in said Formal  
 43 Language Specification ~~formal-specification~~ on the values of attributes of objects have  
 44 been satisfied after execution of a service and reverse any state changes which have  
 45 been made which cause said integrity constraints to be not satisfied ~~take action~~ if said  
 46 integrity constraints are not satisfied; and

47 automatically write code for every object server to test trigger relationships  
 48 specified in said Formal Language Specification ~~formal-specification~~ after execution of a  
 49 service and invoke a predetermined service associated with a trigger event ~~carry-out~~

50        ~~appropriate action~~ if a trigger event has occurred.

1                4. [currently amended] An apparatus for automatically translating a Formal  
2        Language Specification written in any formal language defining a full and complete  
3        Conceptual Model of a desired computer program to be automatically generated into a full  
4        and complete source code which implements said desired computer program,  
5        comprising:

6                a computer programmed with an operating system and one or more other  
7        programs to cooperate with said operating system to control said computer to perform  
8        the following functions:

9                reading all said primitives in said Formal Language Specification in any  
10       order;

11               in any order, using a computer and said Formal Language Specification to  
12       automatically generate computer code which has the capability to control a  
13       computer to carry out generating one or more methods comprised of computer  
14       ~~code which can control a computer to perform the following functions~~ in an order  
15       determined by an execution model:

16               determining if said Formal Language Specification requires user  
17       authentication, and, if so, automatically writing computer code that will  
18       request user name and password, receive any responses and  
19       authenticate the user;

20               determining if said Formal Language Specification requires  
21       determining a user privilege level, and, if so, automatically writing  
22       computer code that will determine a user's privilege level and query said  
23       Formal Language Specification and determine all object attributes said  
24       user has privilege to see and determine all services this user has  
25       privileges to can invoke;

26               determining if said Formal Language Specification defines  
27       services, and, if so, automatically writing computer code which queries  
28       said Formal Language Specification to determine all services that the  
29       authenticated user has privileges to may invoke and which are defined in  
30       said Formal Language Specification for all classes of objects said  
31       authenticated user will be able to view and automatically writing an object

server for each said service which will implement said service upon receipt of a service invocation message, each of said object servers containing code which will perform the following functions in the following order upon receipt of a service invocation message:

verify that one or more proposed state transitions are valid ~~can be validly made~~ for the current state of any object(s) of which said object server will be altering the state before actually altering the state of said object(s);

verify that any preconditions of a service implemented by an object server are satisfied before said object server will act upon said one or more objects to make state transitions thereof in carrying out said service,

ignoring said service invocation message if either said one or more state transitions cannot be validly made for the current state of any objects upon which said object server will be acting or any said precondition is not satisfied;

if all said proposed transitions are valid ~~can be validly made~~ on said one or more objects upon which said object server will act and if all said preconditions are satisfied, make all valuation calculations of said object server required by said Formal Language Specification;

verify that service execution by said object server did not result in violation of one or more integrity constraints specified in said Formal Language Specification on the values of attributes of objects affected by execution of said service implemented by said object server, and take corrective action if one or more of said integrity constraints are not satisfied; and

after a valid change of state of an object acted upon by said object server occurs, test trigger relationships or condition-action rules specified in said Formal Language Specification and, if any trigger event is satisfied, triggering a service specified in said condition-action rule or trigger relationship.

5. [Cancelled]

1 6. [Cancelled]

1 7. [Cancelled]

1 8. [Cancelled]

2 9. [Cancelled]

1 10. [Currently amended] A process for automatically translating a Formal  
2 Language Specification written in any formal language defining a full and complete  
3 Conceptual Model of a desired computer program to be automatically generated into a full  
4 and complete source code which implements said desired computer program,  
5 comprising:

6 reading all said primitives in said Formal Language Specification in any  
7 order;

8 in any order, using a computer and said Formal Language Specification to  
9 automatically generate computer code that has the capability to control a  
10 computer to implement ~~generating~~ one or more methods which perform the  
11 following functions in an order determined by an execution model:

12 determining if said Formal Language Specification requires user  
13 authentication, and, if so, automatically writing computer code that will  
14 request user name and password, receive any responses and  
15 authenticate the user;

16 determining if said Formal Language Specification requires  
17 determining a user privilege level, and, if so, automatically writing  
18 computer code that will determine a user's privilege level and query said  
19 Formal Language Specification and determine all object attributes said  
20 user has privilege to see and determine all services this user has  
21 privileges to ~~can~~-invoke;

22 determining if said Formal Language Specification defines  
23 services, and, if so, automatically writing computer code which queries  
24 said Formal Language Specification to determine all services that the  
25 authenticated user has privileges to ~~may~~-invoke and which are defined in  
26 said Formal Language Specification for all classes of objects said  
27 authenticated user will be able to view and automatically writing an object  
28 server for each said service which will implement said service upon  
29 receipt of a service invocation message, each of said object server



30 containing code which will perform the following functions in the following  
 31 order upon receipt of a service invocation message:

32 verify that one or more proposed state transitions are valid  
 33 ~~can be validly made~~ for the current state of any object(s) of which  
 34 said object server will be altering the state before actually altering  
 35 the state of said object(s);

36 verify that any preconditions of a service implemented by  
 37 an object server are satisfied before said object server will act  
 38 upon said one or more objects to make state transitions thereof in  
 39 carrying out said service,

40 ignoring said service invocation message if either said one  
 41 or more state transitions cannot be validly made for the current  
 42 state of any objects upon which said object server will be acting  
 43 or any said precondition is not satisfied;

44 if all said proposed transitions are valid ~~can be validly made~~  
 45 on said one or more objects upon which said object server will act  
 46 and if all said preconditions are satisfied, make all valuation  
 47 calculations of said object server required by said Formal  
 48 Language Specification;

49 verify that service execution by said object server did not  
 50 result in violation of one or more integrity constraints specified in  
 51 said Formal Language Specification on the values of attributes of  
 52 objects affected by execution of said service implemented by said  
 53 object server, and take corrective action if one or more of said  
 54 integrity constraints are not satisfied; and

55 after a valid change of state of an object acted upon by  
 56 said object server occurs, test trigger relationships or condition-  
 57 action rules specified in said Formal Language Specification and, if  
 58 any trigger event is satisfied, triggering a service specified in said  
 59 condition-action rule or trigger relationship.

1 11. [Cancelled]

1 12. [Cancelled]

1 13. [Previously Presented] A process for converting a Formal Language

2 Specification encoding a Conceptual Model which defines desired system logic and a  
3 desired user interface of a desired computer program into source code which encodes  
4 said desired computer program, comprising:

5       validating said Formal Language Specification to ensure it is complete and correct;

6       retrieving predetermined information from said Formal Language Specification

7 encoding a Conceptual Model which defines one or more classes of objects in an object

8 model, a dynamic model which specifies the behavior of each object in response to

9 services, triggers and global transactions as represented by a state transition diagram

10 for every class and an object interaction diagram for every trigger and for every global

11 transaction, and a functional model which defines the semantics of any change of each

12 object's state as a consequence of an event occurrence by specifying for each class

13 one or more mathematical or logical formulas which define how one or more variable

14 attributes of said class will have their values changed when one or more specified

15 events of said class occurs meaning one or more services of said class is executed;

16       using predetermined information retrieved from said Formal Language

17 Specification to automatically generate source code which implements a presentation tier

18 of said desired computer program;

19       using predetermined information retrieved from said Formal Language

20 Specification to automatically generate source code which implements a persistence tier,

21 database of data structure of said desired computer program;

22       using said predetermined information retrieved from said Formal Language

23 Specification to automatically generate source code which implements a middle tier of

24 said desired program which communicates with said presentation tier in the manner

25 defined below, said middle tier written by automatically generating at least the following

26 component instances for each class defined in said Formal Language Specification:

27       a server component instance including a method to implement each

28 service present in a signature of said class and one or more methods to

29 receive requests from said presentation tier that relate to execution of

30 services of said class;

31       a query component instance including a method for implementing

32 queries to extract information from said persistence tier relating to objects

33 within said class and a method to receive and process requests from said

34 presentation tier to query said persistence tier;

an executive component instance including one or more methods to receive and process a request from said server component or another executive component to execute a service in said class and carry out the following functions:

verify the existence and validity for a requested server component;

create a copy of a requested server component instance in memory and access said persistence tier using said query component to retrieve values of constant and variable attributes of said server component;

validate state transitions for said requested service and a present state for a server component instance;

verify the satisfaction of preconditions specified in said Formal Language Specification of said requested service;

changing the state of said server component instance to a new state by modifying a value of a variable attribute of said server component instance by performing all valuations specified in said functional model affected by said requested service;

validating said new state by verifying said new state does not violate static or dynamic restrictions specified in said Formal Language Specification;

check trigger conditions established in said Formal Language Specification to determine if said new state causes any trigger to occur, and, if so, which actions should be carried out;

communicate with said persistence tier to access or store all attributes of said server component instance.

14. [currently amended] A process for validating a ~~formal language specification~~ Formal Language Specification, comprising the steps:

A) checking said ~~formal language specification~~ Formal Language Specification to ensure that it is complete in that all required properties of a Conceptual Model embodied in said ~~formal language specification~~ Formal Language Specification are defined and have a valid value;

7 B) using rules of grammar of whatever formal language said ~~formal~~  
 8 ~~language specification~~Formal Language Specification is written in, checking said  
 9 ~~formal language specification~~Formal Language Specification to ensure it is correct  
 10 in that it is syntactically and semantically correct and not ambiguous.

1 15. [Previously Presented] The process of claim 14 further comprising the step  
 2 of presenting a request for said missing information via a mechanism of a user interface  
 3 if any information is missing or presenting a request via a user interface mechanism to  
 4 correct any syntactic or semantic error or clarify any ambiguity discovered during said  
 5 validation process.

1 16. [Currently Amended] The process of claim 14 further comprising the step of  
 2 doing a partial validation each time an element is added to said ~~formal language~~  
 3 ~~specification~~Formal Language Specification to check for completeness and correctness  
 4 and mark the portion of said ~~formal language specification~~Formal Language Specification  
 5 just added as invalid if an error is found so that a request to correct said error ~~is~~ can be  
 6 presented later when a full validation of said ~~formal language specification~~Formal  
 7 Language Specification is requested.

1 17. [Previously Presented] The process of claim 14 wherein step A comprises  
 2 checking to ensure that all elements in said Conceptual Model have a set of properties  
 3 that exist and have a valid value and wherein step B comprises using a predetermined  
 4 process and grammar for every type of formula in said Conceptual Model to ensure each  
 5 is syntactically and semantically correct.

1 18. [Previously Presented] The process of claim 14 wherein step A comprises  
 2 performing strict validation on some element properties and flexible validation of other  
 3 element properties of said Conceptual Model, said strict validation of a property defined  
 4 as requiring a full definition and valid value for a property, and flexible validation defined  
 5 as allowing a property to be incomplete or have an invalid value during a process of  
 6 inputting elements which define said Conceptual Model, and wherein the following table  
 7 defines which elements and properties have strict or flexible validations:

Element	Property	Subproperty	Validation Type
<b>class</b>			
	<b>name</b>		<b>strict</b>
	<b>ID function</b>		<b>flexible</b>
	<b>attributes (at least one)</b>		<b>flexible</b>
	<b>services (at least a Create service)</b>		<b>flexible</b>
	<b>static and dynamic integrity constraints</b>	<b>their formulas</b>	<b>strict</b>
<b>attribute</b>			
	<b>name</b>		<b>strict</b>
	<b>type (constant, variable, derived)</b>		<b>strict</b>
	<b>data-type (real, integer, etc.)</b>		<b>strict</b>
	<b>default value</b>		<b>strict</b>
	<b>size</b>		<b>strict</b>
	<b>request in creation service</b>		<b>strict</b>
	<b>null value allowed</b>		<b>strict</b>
	<b>evaluations (variable attributes)</b>		<b>flexible</b>
	<b>derivation formula (derived attributes)</b>		<b>flexible</b>

Evaluation			
	one variable attribute of a class		strict
	one service of the same class		strict
	condition		strict
	formula of evaluation		strict
derivation			
	formula		strict
	condition (optional)		strict
service			
	name		strict
	arguments		
		argument's name	strict
		data type	strict
		default value (optional)	strict
		null value	strict
		size (if proceeds)	strict
		formula of transaction	flexible
preconditions of an action			
	formula		strict

		agents affected by condition	strict
relationship: aggregation			
	related classes (component and composite)		strict
	relationship name		strict
	both directions: role names		strict
	cardinality		strict
	inclusive or referential		strict
	dynamic		strict
	clause "group by" (optional)		strict
	insertion and deletion events (if proceed)		strict
relationship: inheritance			
	related classes (parent & child)		strict
	temporal (versus permanent)		strict
	specialization condition or events		strict

relationship: agent			
	agent class and service allowed to activate		strict
state transition diagram			
	all states of classes (three at least)		flexible
state in state transition diagram			
	name		strict
transition in state transition diagram			
	estate of origin		strict
	estate of destination		strict
	service of class		strict
		control condition (optional)	strict
trigger			
	condition		strict
	class or instance of destination		strict
	target (self, object, class)		strict
	activated service		strict



	service arguments' initialization (optional)		
		argument values	strict
global interactions			
	name		strict
	formula		strict
user exit functions			
	name		strict
	return data-type		strict
	arguments, (optional)		
	argument's name		strict
	argument's data- type		strict.

1           19. [Previously Presented] The process of claim 14 wherein step B comprises  
2 validating formulas to ensure each formula complies with a precise syntax defined for a  
3 formula of that type and is semantically correct, where there are several types of  
4 formulas, and wherein a predetermined process for validation and a set of rules of  
5 grammar exist for each type of formula and a validation process and a set of rules  
6 appropriate for the type of formula being validated is used for validation of each formula.

1           20. [Currently Amended] The process of claim 14 wherein step B comprises  
2 validating formulas to ensure each formula complies with a precise syntax defined for a  
3 formula of that type and is semantically correct, where there are several types of  
4 formulas defined by the table below:

default value calculation of	
	class attributes (constant and variable)
	service and transaction arguments
inheritance: specialization conditions	
static and dynamic integrity constraints	
derivations and valuations	
	effect formula (derived or variable attributes respectively)
	conditions (optional)
preconditions for actions	
control conditions for transitions in state transition diagram	
triggering conditions	
local and global transactions formulas	

1 and further comprising the steps of:

2                   presenting dialog boxes via a user interface by which a user is provided a  
3                   mechanism to ~~may~~-enter said formulas during a process of defining said  
4                   Conceptual Model;

5 and wherein step B is performed by preventing a user from leaving a dialog box being  
6 used to define a formula until said formula being defined is syntactically and semantically  
7 correct.

1                   21. [Previously Presented] The process of claim 14 wherein steps A and B are  
2 performed by at least checking to ensure that every formula is syntactically correct,  
3 every class has an identification function and has a creation event and a destroy event,  
4 every triggering formula is semantically correct, every name of an aggregation is unique  
5 in the scheme of said Conceptual Model, every derived attribute has at least a derivation  
6 formula, every service has an agent or server declared to execute it.

1           22. [Currently Amended] The process of claim 14 further comprising performing  
2 steps A and B each time a user working on defining said Conceptual Model makes a  
3 change which may invalidate one or more formulas, but wherein predetermined formulas  
4 are allowed to be temporarily incorrect so that the user is presented them for can review  
5 ~~them~~ at a later time if they are still incorrect when a full validation process is performed  
6 after the user is done defining the Conceptual Model.

1           23. [Currently Amended] The process of claim 14 further comprising the step of  
2 using a computer to automatically translate said ~~formal language specification~~ Formal  
3 Language Specification into computer code after steps A and B and been completed and  
4 all formulas are syntactically and semantically complete and correct.

1           24. [Currently Amended] The process of claim 14 further comprising the steps:  
2           presenting user interface tools by which a user may define said  
3 Conceptual Model and make changes thereto;  
4           checking all affected formulas each time a change is made to said  
5 Conceptual Model;  
6           if the change affects a strictly validated property, then the change is  
7 rejected if the property is not given a valid value, otherwise the change is  
8 accepted;  
9           if the change affects a property which is not strictly validated, then the  
10 user is informed should any error arise, but allowed to do the modification if said  
11 user ~~he or she~~ wishes;  
12           if there are no affected formulas, modifying the Conceptual Model as  
13 specified by the user.

1           25. [Currently Amended] The process of claim 14 wherein user interface defining  
2 portions of said ~~formal language specification~~ Formal Language Specification are  
3 validated by:  
4           verifying that any patterns defined by said user are acceptable user  
5 interface patterns with no essential information missing;  
6           attributes used in filters specified as part of said user interface are visible

7 from a definition class;  
 8 attributes used in order criteria are visible from a definition class;  
 9 any formula in a filter is syntactically and semantically correct and uses  
 10 only terms defined in said Conceptual Model;  
 11 any action selection pattern uses as final actions object defined in said  
 12 Conceptual Model;  
 13 any set of dependency patterns are terminal and have confluence; and  
 14 warnings are displayed to said user if any pattern is defined but not used or if an  
 15 instance pattern is duplicated.

1 26. [Currently Amended] An apparatus comprising a computer programmed with  
 2 an operating system and a validation program that cooperates with said operating system  
 3 to control said computer to perform the following functions of a validation process:

4 A) check a ~~formal language specification~~ Formal Language Specification  
 5 for completeness by checking to ensure said ~~formal language specification~~ Formal  
 6 Language Specification has no missing information which is needed to detail the  
 7 requirements of a desired computer program modelled by said ~~formal language~~  
 8 ~~specification~~ Formal Language Specification;

9 Bb) cooperate with said operating system to ensure said ~~formal language~~  
 10 ~~specification~~ Formal Language Specification is correct by checking each  
 11 statement in said ~~formal language specification~~ Formal Language Specification  
 12 according to rules of grammar of whatever formal language in which said ~~formal~~  
 13 ~~language specification~~ Formal Language Specification is written to ensure that  
 14 each statement is syntactically and semantically correct and not ambiguous so as  
 15 to ensure that all properties of elements in a Conceptual Model encoded in said  
 16 ~~formal language specification~~ Formal Language Specification have a value which  
 17 is valid and to ensure that all formulas in said Conceptual Model have correct  
 18 syntax and meaning.

1 27. [Previously Presented] The apparatus of claim 26 wherein said validation  
 2 program controls said computer to perform the following additional function:

3 presenting a request for said missing information via a mechanism of a  
 4 user interface if any information is missing or presenting a request via a user

5 interface mechanism to correct any syntactic or semantic error or clarify any  
6 ambiguity discovered during said validation process.

1 28. [Currently Amended] The apparatus of claim 26 wherein said validation  
2 program controls said computer to perform the following additional function:  
3 doing a partial validation each time an element is added to said ~~formal~~  
4 ~~language specification~~ Formal Language Specification to check for completeness  
5 and correctness and mark the portion of said ~~formal language specification~~ Formal  
6 Language Specification just added as invalid if an error is found so that a request  
7 to correct said error ~~is can be~~ presented later when a full validation of said ~~formal~~  
8 ~~language specification~~ Formal Language Specification is requested if said error  
9 still exists.

1 29. [Previously Presented] The apparatus of claim 26 wherein said validation  
2 program controls said computer to perform the following additional function:  
3 checking to ensure that all elements in said Conceptual Model have a set  
4 of properties that exist and have a valid value;  
5 performing step B by using a predetermined process and grammar for  
6 every type of formula in said Conceptual Model to ensure each is syntactically  
7 and semantically correct.

1 30. [Previously Presented] The apparatus of claim 26 wherein said validation  
2 program controls said computer to perform step B by validating formulas to ensure each  
3 formula complies with a precise syntax defined for a formula of that type and is  
4 semantically correct, where there are several types of formulas, and wherein a  
5 predetermined process for validation and a set of rules of grammar exist for each type of  
6 formula and a validation process and a set of rules appropriate for the type of formula  
7 being validated is used for validation of each formula.

1 31. [Previously Presented] The apparatus of claim 26 wherein said validation  
2 program controls said computer to perform step B by validating formulas to ensure each  
3 formula complies with a precise syntax defined for a formula of that type and is  
4 semantically correct, where there are several types of formulas defined by the table

5 below:

default value calculation of	
	class attributes (constant and variable)
	service and transaction arguments
inheritance: specialization conditions	
static and dynamic integrity constraints	
derivations and valuations	
	effect formula (derived or variable attributes respectively)
	conditions (optional)
preconditions for actions	
control conditions for transitions in state transition diagram	
triggering conditions	
local and global transactions formulas	

6 and wherein said validation program is further structured to control said computer to  
7 perform the steps of:

8                   presenting dialog boxes via a user interface by which a user may enter  
9                   said formulas during a process of defining said Conceptual Model;

10 and wherein step B is performed by preventing a user from leaving a dialog box being  
11 used to define a formula until said formula being defined is syntactically and semantically  
12 correct.

1                   32. [Currently Amended] The apparatus of claim 26 wherein said validation  
2 program controls said computer to perform the following steps:

3                   presenting user interface tools by which a user may define said  
4                   Conceptual Model and make changes thereto;

5                   checking all affected formulas each time a change is made to said

6 Conceptual Model;

7 if the change affects a strictly validated property, then the change is  
8 rejected if the property is not given a valid value, otherwise the change is  
9 accepted;

10 if the change affects a property which is not strictly validated, then the  
11 user is informed should any error arise, but allowed to do the modification if said  
12 user ~~he or she~~ wishes;

13 if there are no affected formulas, modifying the Conceptual Model as  
14 specified by the user.

1 33. [Currently Amended] ~~An~~ A physical computer readable storage media ~~medium~~  
2 having stored thereon computer-readable instructions which when executed by a  
3 computer implement a validation program to control said computer to perform the  
4 following functions of a validation process:

5 A) check a ~~formal language specification~~ Formal Language Specification  
6 for completeness by checking to ensure said ~~formal language specification~~ Formal  
7 Language Specification has no missing information which is needed to detail the  
8 requirements of a desired computer program modelled by said ~~formal language~~  
9 ~~specification~~ Formal Language Specification;

10 ~~Bb)~~ Bb) cooperate with said operating system to ensure said ~~formal language~~  
11 ~~specification~~ Formal Language Specification is correct by checking each  
12 statement in said ~~formal language specification~~ Formal Language Specification  
13 according to rules of grammar of whatever formal language in which said ~~formal~~  
14 ~~language specification~~ Formal Language Specification is written to ensure that  
15 each statement is syntactically and semantically correct and not ambiguous so as  
16 to ensure that all properties of elements in a Conceptual Model encoded in said  
17 ~~formal language specification~~ Formal Language Specification have a value which  
18 is valid and to ensure that all formulas in said Conceptual Model have correct  
19 syntax and meaning.

1 34. [Previously Presented] The computer-readable medium of claim 33 wherein  
2 said validation program is further structured to control said computer to perform the  
3 following additional function:

4                   presenting a request for said missing information via a mechanism of a  
5                   user interface if any information is missing or presenting a request via a user  
6                   interface mechanism to correct any syntactic or semantic error or clarify any  
7                   ambiguity discovered during said validation process.

1                   35. [Currently Amended] The computer-readable medium of claim 33 wherein said  
2                   validation program is further structured to control said computer to perform the following  
3                   additional function:

4                   doing a partial validation each time an element is added to said ~~formal~~  
5                   ~~language specification~~Formal Language Specification to check for completeness  
6                   and correctness and mark the portion of said ~~formal language specification~~Formal  
7                   Language Specification just added as invalid if an error is found so that a request  
8                   to correct said error ~~is can be~~ presented later when a full validation of said ~~formal~~  
9                   ~~language specification~~Formal Language Specification is requested if said error  
10                  still exists.

1                   36. [Previously Presented] The computer-readable medium of claim 33 wherein  
2                   said validation program is further structured to control said computer to perform the  
3                   following additional functions:

4                   checking to ensure that all elements in said Conceptual Model have a set  
5                   of properties that exist and have a valid value;

6                   performing step B by using a predetermined process and grammar for  
7                   every type of formula in said Conceptual Model to ensure each is syntactically  
8                   and semantically correct.

1                   37. [Previously Presented] The computer-readable medium of claim 29 wherein  
2                   said validation program is structured to control said computer to perform step B by  
3                   validating formulas to ensure each formula complies with a precise syntax defined for a  
4                   formula of that type and is semantically correct, where there are several types of  
5                   formulas, and wherein a predetermined process for validation and a set of rules of  
6                   grammar exist for each type of formula and a validation process and a set of rules  
7                   appropriate for the type of formula being validated is used for validation of each formula.



38. [Previously Presented] The computer-readable medium of claim 33 wherein said validation program is structured to control said computer to perform step B by validating formulas to ensure each formula complies with a precise syntax defined for a formula of that type and is semantically correct, where there are several types of formulas defined by the table below:

default value calculation of	
	class attributes (constant and variable)
	service and transaction arguments
inheritance: specialization conditions	
static and dynamic integrity constraints	
derivations and valuations	
	effect formula (derived or variable attributes respectively)
	conditions (optional)
preconditions for actions	
control conditions for transitions in state transition diagram	
triggering conditions	
local and global transactions formulas	

and wherein said validation program is further structured to control said computer to perform the steps of:

presenting dialog boxes via a user interface by which a user may enter said formulas during a process of defining said Conceptual Model;

and wherein step B is performed by preventing a user from leaving a dialog box being used to define a formula until said formula being defined is syntactically and semantically correct.

39. [Currently Amended] The computer-readable medium of claim 33 wherein said

validation program is structured to control said computer to perform the following steps:

presenting user interface tools by which a user may define said

Conceptual Model and make changes thereto;

checking all affected formulas each time a change is made to said  
Conceptual Model;

if the change affects a strictly validated property, then the change is  
rejected if the property is not given a valid value, otherwise the change is  
accepted;

if the change affects a property which is not strictly validated, then the  
user is informed should any error arise, but allowed to do the modification if said  
user ~~he or she~~ wishes;

if there are no affected formulas, modifying the Conceptual Model as  
specified by the user.

40. [New] A process to automatically translate a Formal Language Specification  
defining the functionality of a computer application modelled in a Conceptual Model, into a  
computer program called an application, said process comprising the steps of:

A) validating said Formal Language Specification to ensure said Formal  
Language Specification is complete in that there is no missing information in said  
Formal Language Specification and to ensure said Formal Language Specification  
is correct in that primitives of said conceptual model are syntactically and  
semantically consistent and not ambiguous;

B) translating said validated Formal Language Specification into computer  
readable code which has the capability to control a computer to provide a user  
interface access mechanism to allow users to log in by entering at least  
identification data and to use said identification data to authenticate and validate a  
user as an instance of a class of the validated fFormal Language Specification  
that act as agent in at least one agent relationship;

C) translating said validated Formal Language Specification into computer  
readable code which has the capability to control a computer to provide a view of  
the system defining the set of objects and attributes the user can query and the  
set of services said user can execute, the content of said system view

19 depending on the identity of said user accessing said application;  
20 and  
21 D) translating said validated Formal Language Specification into computer  
22 readable code which has the capability to control a computer to provide user  
23 interface interaction mechanisms to interact with and execute the functionality of  
24 the application in terms of performing queries on information managed by said  
25 application and executing services to modify the state of said information  
26 managed by said application, said services comprising events, local transactions  
27 and global transactions.

1 41. [New] The process of claim 40 wherein Step D comprises translating said  
2 Formal Language Specification into computer code which has the capability to control a  
3 computer so as to implement functionality of said queries as defined in said validated  
4 Formal Language Specification by means of filter formulas of filter patterns representing  
5 said queries, and so as to implement functionality of said services as defined in said  
6 validated Formal Language Specification in terms of:  
7 - at least a valuation for each variable attribute of each class in said validated  
8 Formal Language Specification associated to at least an event of said class,  
9 which altogether define the functionality of every event;  
10 - a transaction formula that defines a composition of services into a molecular  
11 execution unit, thereby defining functionality of every local transaction and global  
12 transaction;  
13 - state transitions to control the valid lives for objects of each class in said  
14 validated Formal Language Specification, upon occurrence of an event or a local  
15 transaction;  
16 - optional preconditions to the execution of services; and  
17 - optional integrity constraints to prevent the execution of services from leaving the  
18 information managed by said application in an inconsistent or invalid state.

1 42. [New] The process of claim 40 wherein said step B creates computer  
2 readable code which has the capability to control a computer to provide user interface  
3 access mechanisms which block access such that only users that belong to any class  
4 of said view for which said computer application is produced can connect or log on to

5 said desired computer program, said control being performed by requesting that a user  
6 wishing to log onto said desired computer program indicate information that identifies a  
7 class of which said user is an instance, and also indicate information that identifies the  
8 user as an instance of said class so as to identify said user, and also indicate  
9 information that is used as a password for that user so as to authenticate said user.

1 43. [New] The process of claim 40 wherein said step C creates computer  
2 readable code which has the capability to control a computer to provide said view of the  
3 system in such a manner that said system view comprises user interaction mechanisms  
4 included in an Action Selection Presentation Pattern associated with said view for which  
5 the application is produced.

1 44. [New] The process of claim 43 wherein step C creates computer readable  
2 code which has the capability to control a computer to restrict the user interface  
3 interaction mechanisms to the ones the user who logged on is allowed to interact with  
4 according to privileges established by data structures which relate the class said user  
5 belongs to, playing the role of agent, with classes, playing the role of servers, that  
6 determine which services of each server class will be available for execution by said  
7 user and which attributes of each server class said user will be able to query.

1 45. [New] The process of claim 40 wherein step D comprises translating said  
2 validated Formal Language Specification into computer readable code which has the  
3 capability to control a computer to provide user interface interaction mechanisms which  
4 allow a user who has logged on to interact with and access functionality of said  
5 computer application by invoking services, executing queries and/or execution of user  
6 interface interaction scenarios.

1 46. [New] The process of claim 45 wherein step D comprises the steps of  
2 translating said Formal Language Specification into computer readable code which has  
3 the capability to control a computer to provide user interface interaction mechanisms  
4 which allow a user who has logged in to interact with and access the functionality of  
5 said computer application by execution of only selected services selected from a group  
6 of services comprising events, local transactions and/or global transactions and

7 depending upon the identity of said user.

1 47. [New ] The process of claim 46 where the steps in step D of translating said  
2 Formal Language Specification to generate computer readable code which controls a  
3 computer to allow a logged on user to interact with and execute the functionality  
4 associated to an event comprise generating code which controls a computer to provide a  
5 mechanism to construct the message associated to said event and to execute said  
6 event.

1 48. [New] The process of claim 47 wherein said step D includes the steps of  
2 translating said validated Formal Language Specification to generate computer readable  
3 code which controls a computer to provide a mechanism to construct said message  
4 associated to said event comprises generating code to control a computer to perform the  
5 following steps:

- 6 - providing a mechanism to identify the object on which the event will be  
7 executed, except if said event is a creation event, in which case this  
8 step will be omitted;
- 9 - providing mechanisms to give a value to every argument of said event,  
10 said mechanisms further controlling that arguments that require a value  
11 are provided a value and that any argument whose value is provided  
12 receives a valid value.

1 49. [New] The process of claim 47 wherein said step D includes the steps of  
2 translating said validated Formal Language Specification to generate computer readable  
3 code which has the capability to control a computer to provide a mechanism to execute a  
4 service which is an event and comprises the following steps:

- 5 - translating said validated Formal Language Specification so as to provide  
6 code which controls a computer to provide a mechanism to, except in the  
7 case of a creation event, verify the existence of said object on which  
8 said event will be executed, or the non-existence of the object to be  
9 created in the case of a creation event;
- 10 - translating said validated Formal Language Specification so as to provide  
11 code which controls a computer to provide a mechanism to, except in the

12 case of a creation event, recover the state of the object on which the  
13 event is executed from whatever memory or database or repository or  
14 any other persistence means (hereafter just "memory") to which said  
15 state of said object has been saved;

- 16 - translating said validated Formal Language Specification so as to provide  
17 code which controls a computer to provide a mechanism to verify that,  
18 according to the state transition diagram of the class owning said event,  
19 there is a valid state transition labelled with said event being executed  
20 and for the agent class to which the user belongs who logged onto said  
21 desired computer program, in which case said mechanism will update the  
22 state of the object on which the event is executed according to said  
23 state transition diagram, and if there is no valid state transition, said  
24 mechanism will produce an error message causing the execution of the  
25 event to stop and roll back all changes made to the state of the object on  
26 which said event is executed
- 27 - translating said validated Formal Language Specification so as to provide  
28 code which controls a computer to provide a mechanism to verify that  
29 every precondition that is defined for said event being executed and for  
30 said agent class to which the user logged on to the computer application  
31 belongs, is satisfied, and should any of said preconditions not be  
32 satisfied, then said mechanism will produce an error with the error  
33 message being predefined for said precondition that does not hold  
34 causing the execution of the event to stop and roll back all changes made  
35 to the state of said object on which said event is executed;
- 36 - except in the case of creation events or destruction events, translating  
37 said validated Formal Language Specification so as to provide code  
38 which controls a computer to provide a mechanism to produce the  
39 changes of values to the variable attributes of said class owning said  
40 event for which valuation formulas in said functional model have been  
41 defined such that said valuations relate said variable attributes with the  
42 event being executed, and wherein said mechanism applies only the  
43 changes to the variable attributes which are required by valuation  
44 formulas of valuations whose valuation condition formula evaluates to

45 true, if any, or the change required by a valuation formula of a valuation  
46 having no valuation condition formula;

47 - in the case of a creation event, translating said validated Formal  
48 Language Specification so as to provide code which has the capability to  
49 control a computer to provide a mechanism to assign a value to every  
50 constant or variable attribute of an object on which said creation event is  
51 executed and establishing relationships between said object on which  
52 said creation event is executed with objects of classes related with the  
53 class owning said creation event;

54 - in the case of a destruction event, translating said validated Formal  
55 Language Specification so as to provide code which has the capability to  
56 control a computer to provide a mechanism to delete relationships of the  
57 object on which said destruction event is executed with objects said  
58 object is related to;

59 - except in the case of destruction events, translating said validated  
60 Formal Language Specification so as to provide code which has the  
61 capability to control a computer to provide a mechanism to check that  
62 every integrity constraint defined in the class owning said event is  
63 satisfied, for the object whose state has been changed by said event,  
64 and should any of said integrity constraints not be satisfied, said  
65 mechanism will produce an error with the error message predefined for  
66 said integrity constraint that does not hold, said mechanism causing the  
67 execution of the event to stop and roll back all changes made to the state  
68 of the object on which the event is executed;

69 - except in the case of a destruction event, translating said validated  
70 Formal Language Specification so as to provide code which has the  
71 capability to control a computer to provide a mechanism to save the  
72 changes made to said object on which the event is executed to memory;

73 - in the case of a destruction event, translating said validated Formal  
74 Language Specification so as to provide code which has the capability to  
75 control a computer to provide a mechanism to delete the object on which  
76 said destruction event is executed from memory to which said object has  
77 been saved;

- 78                   -       except in the case of a destruction event, translating said validated  
79                            Formal Language Specification so as to provide code which has the  
80                            capability to control a computer to provide a mechanism to check every  
81                            trigger condition on said object on which said event is executed for  
82                            every trigger relationship defined on said class owning said event, and  
83                            wherein for every trigger condition that holds, a mechanism to execute  
84                            the service associated to said trigger relationship by:
- 85                            •   providing a mechanism to determine the set of objects on  
86                                which said service associated to said trigger will be executed,  
87                                and
  - 88                            •   executing said service on every object of said set of objects  
89                                by:
    - 90                                •   giving a value to every argument of said service, and  
91                                ensuring that every argument that requires a value is  
92                                provided a value and that any argument whose value is  
93                                provided receives a valid value; and
    - 94                                •   invoking the execution of said service on said object;
- 95                            and
- 96                   -       translating said validated Formal Language Specification so as to provide  
97                            code which has the capability to control a computer to provide a  
98                            mechanism to inform the requestor of the result of executing the event.

1                   50. [NEW] The process of claim 46 where the steps in step D of translating said  
2                   Formal Language Specification to generate computer readable code which controls a  
3                   computer to allow a logged on user to interact with and execute the functionality  
4                   associated to a local transaction comprise generating code which controls a computer to  
5                   provide a mechanism to construct the message associated to said local transaction and  
6                   to execute said local transaction.

1                   51. [New] The process of claim 50 wherein the steps in step D of translating said  
2                   Formal Language Specification to generate computer readable code which controls a  
3                   computer to provide a mechanism to construct said message associated to the local  
4                   transaction comprise generating code to control a computer to perform the following



5 steps:

- 6 - providing a mechanism to identify the object on which said local  
7 transaction will be primarily executed, except if said transaction is a  
8 creation service, in which case this step will be omitted;
- 9 - providing mechanisms to give a value to every argument of said local  
10 transaction, said mechanisms further controlling that arguments that  
11 require a value are provided a value and that any argument whose value  
12 is provided receives a valid value.

1 52. [New] The process of claim 50 wherein said step D includes the steps of  
2 translating said validated Formal Language Specification to generate computer readable  
3 code which has the capability to control a computer to execute a service which is a local  
4 transaction and comprises the following steps:

- 5 - translating said validated Formal Language Specification so as to provide code  
6 which controls a computer to provide a mechanism to, except in the case of a  
7 creation service, verify the existence of the object on which the local  
8 transaction will be executed or, in the case of a creation service, verify the  
9 non-existence of the object to be created;
- 10 - translating said validated Formal Language Specification so as to provide code  
11 which controls a computer to, except in the case of a creation service,  
12 provide a mechanism to recover the state of the object on which the local  
13 transaction is executed from memory to which the state of said object has  
14 been saved;
- 15 - translating said validated Formal Language Specification so as to provide code  
16 which controls a computer to provide a mechanism to verify that, according to  
17 the state transition diagram of the class owning said local transaction, there is  
18 a valid state transition labelled with said local transaction being executed and  
19 for the agent class to which the user logged on to the system belongs, and, if  
20 there is such a valid state transition, said mechanism will update the state of  
21 the object on which the local transaction is executed according to said state  
22 transition diagram, and, if there is no such valid state transition, said  
23 mechanism will produce an error message causing the execution of said local  
24 transaction to stop and roll back all changes made to the state of said object

25 on which the local transaction is executed and of any other object the state of  
26 which has been modified by the execution of said local transaction;  
27 - translating said validated Formal Language Specification so as to provide code  
28 which controls a computer to provide a mechanism to verify that every  
29 precondition that is defined for the local transaction being executed and for  
30 the agent class to which the user logged on to the system belongs, is  
31 satisfied, and should any of said preconditions not hold, then said mechanism  
32 will produce an error with the error message defined for said precondition  
33 that does not hold causing the execution of said local transaction to stop and  
34 roll back all changes made to the state of the object on which said local  
35 transaction is executed and of any other object the state of which has been  
36 modified by the execution of said local transaction;  
37 - for every service comprised in the transaction formula of said local  
38 transaction being executed:  
39     o if said service has an associated guard, translating said validated  
40       Formal Language Specification so as to provide code which controls a  
41       computer to provide a mechanism to check that said guard associated  
42       to said service holds; and if said guard does not hold, the rest of the  
43       steps associated to said service will be omitted;  
44     o translating said validated Formal Language Specification so as to  
45       provide code which controls a computer to provide a mechanism to  
46       determine the set of objects on which said service comprised in said  
47       transaction formula will be executed and to provide a mechanism to  
48       execute said service on every object of said set of objects by:  
49       • providing mechanisms to give a value to every argument of said  
50       service, said mechanisms further ensuring that arguments that  
51       require a value are provided a value and that any argument whose  
52       value is provided receives a valid value;  
53       • providing a mechanism to invoke the execution of said service on  
54       said object and control the result of said execution, and should said  
55       execution result in an error, causing the execution of the local  
56       transaction to stop and roll back all changes made to the state of  
57       said object on which the local transaction is executed and of any

58 other object the state of which has been modified by the execution  
59 of said local transaction

60 - translating said validated Formal Language Specification so as to provide code  
61 which has the capability to control a computer to provide a mechanism to  
62 check that every integrity constraint holds which is defined in the class  
63 owning the local transaction and in classes whose instances include objects  
64 the state of which has been modified by the execution of said local  
65 transaction, for any object whose state has been changed by said local  
66 transaction, and, should any of said integrity constraints not hold, said  
67 mechanism produces an error with an error message defined for said integrity  
68 constraint that does not hold and causing the execution of said local  
69 transaction to stop and roll back all changes made to the state of the object on  
70 which the local transaction is executed and of any other object the state of  
71 which has been modified by the execution of said local transaction;

72 - translating said validated Formal Language Specification so as to provide code  
73 which has the capability to control a computer to provide a mechanism to  
74 check every trigger condition on any object the state of which has been  
75 modified by the execution of said local transaction, for every trigger  
76 relationship defined on each class owning an object the state of which has  
77 been changed by execution of said local transaction, and for every trigger  
78 condition that holds, a mechanism to execute the service associated to said  
79 trigger relationship by:

- 80 • providing a mechanism to determine the set of objects on which said  
81 service associated to said trigger will be executed, and
- 82 • providing a mechanism to execute said service on every object of  
83 said set of objects by:
  - 84 • giving a value to every argument of said service, and
  - 85 ensuring that every argument that requires a value is
  - 86 provided a value and that any argument whose value is
  - 87 provided receives a valid value; and
  - 88 • invoking the execution of said service on said object;

89 and

90 - translating said validated Formal Language Specification so as to provide code

91                   which has the capability to control a computer to provide a mechanism so as  
92                   to inform the requestor of the result of executing said local transaction.

1           53. [New] The process of claim 46 wherein the steps in step D of translating said  
2           Formal Language Specification to generate computer readable code which controls a  
3           computer to allow a logged on user to interact with and execute the functionality  
4           associated to a global transaction comprise generating code which controls a computer  
5           to provide a mechanism to construct the message associated to said global transaction  
6           and to execute said global transaction.

1           54. [New] The process of claim 53 wherein the steps in step D of translating said  
2           Formal Language Specification to generate computer readable code which controls a  
3           computer to provide a mechanism to construct said message associated to said global  
4           transaction comprises the step of generating code which controls a computer to provide  
5           mechanisms to give a value to every argument of the global transaction, said  
6           mechanisms further controlling that arguments that require a value are provided a value  
7           and that any argument whose value is provided receives a valid value.

1           55. [New] The process of claim 53 wherein said step D includes the steps of  
2           translating said validated formal language specification to generate computer readable  
3           code which can control a computer to execute a service which is a global transaction  
4           and comprises the following steps:

- 5           -           translating said validated formal language specification so as to provide code  
6                        which controls a computer to provide a mechanism to verify that every  
7                        precondition that is defined for the global transaction being executed and for  
8                        the agent class the user logged on to the system belongs to, is satisfied, and  
9                        should any of said preconditions not hold, then said mechanism will produce  
10                      an error with the error message being defined for said precondition that does  
11                      not hold, and causing execution of said global transaction to stop and roll back  
12                      all changes made to any object the state of which has been modified by  
13                      execution of said global transaction;
- 14           -           for every service included in a transaction formula of said global transaction  
15                        being executed:

- o if said service has an associated guard, translating said validated formal language specification so as to provide code which controls a computer to provide a mechanism to check that said guard associated to said service holds, and if said guard does not hold, the rest of the steps associated to said service will be omitted;
- o translating said validated formal language specification so as to provide code which controls a computer to provide a mechanism to determine the set of objects on which said service will be executed and to provide a mechanism to execute said service on every object of said set of objects by:
  - providing mechanisms to give a value to every argument of said service, said mechanisms further ensuring that arguments that require a value are provided a value and that any argument whose value is provided receives a valid value;
  - providing a mechanism to invoke the execution of said service on said object and control the result of said execution, and should said execution result in an error, causing the execution of the global transaction to stop and roll back all changes made to the state of any object the state of which might have been modified by the execution of said global transaction;
- translating said validated formal language specification so as to provide code which can control a computer to provide a mechanism to check that every integrity constraint holds that is defined in classes whose instances include objects the state of which has been modified by the execution of said global transaction, for any object whose state has been changed by said global transaction, and should any of said integrity constraints not hold, said mechanism produces an error with an error message defined for said integrity constraint that does not hold thereby causing execution of said global transaction to stop and roll back all changes made to any object the state of which has been modified by execution of said global transaction;
- translating said validated formal language specification so as to provide code which can control a computer to provide a mechanism to check every trigger condition on any object the state of which has been modified by execution of

said global transaction, for every trigger relationship defined on each class owning any object the state of which has changed by execution of said global transaction, and, for every trigger condition that holds, a mechanism to execute the service associated to said trigger relationship by:

- providing a mechanism to determine a set of objects on which said service associated to said trigger will be executed, and
- providing a mechanism to execute said service on every object of said set of objects by:
  - giving a value to every argument of said service, and ensuring that every argument that requires a value is provided a value and that any argument whose value is provided receives a valid value; and
  - invoking the execution of said service on said object;

and

- translating said validated formal language specification so as to provide code which can control a computer to provide a mechanism so as to inform the requestor of the result of executing said global transaction.

56. [New] The process of claim 45 wherein the steps in step D of translating said formal language specification to generate computer readable code which can control a computer to allow a logged on user to interact with and execute the functionality of a query as part of filter patterns independently or in the context of a Class Population Presentation Pattern comprise generating computer code to control said computer to provide a mechanism to construct the message associated with said filter and to execute the query associated with said filter.

57. [NEW] The process of claim 56 wherein said step D includes the steps of translating said validated formal language specification to generate computer readable code which can control a computer to provide a mechanism to construct said message associated to the filter comprise generating code to control a computer to perform the following steps:

- providing a mechanism to indicate a filter whose associated query is to be executed;

- 8        -        providing mechanisms to give a value to every filter variable of a filter pattern
- 9                of said filter, said mechanisms further controlling that filter variables that
- 10               require a value are provided a value and that any filter variable whose value
- 11               is provided receives a valid value;
- 12        -        providing a mechanism to indicate a display set pattern to be used in
- 13                performing the query
- 14        -        providing a mechanism to indicate an order criterion pattern, if any, to be used
- 15                in performing said query.

- 1        58. [New] The process of claim 57 wherein said step D includes the steps of
- 2        translating said validated formal language specification to generate computer readable
- 3        code which can control a computer to provide a mechanism to execute the query
- 4        associated with said filter and comprises the following steps:
- 5        -        translating said validated formal language specification so as to provide code
  - 6                which controls a computer to provide a mechanism to access the population
  - 7                of instances of the class owning said filter pattern from memory;
  - 8        -        translating said validated formal language specification so as to provide code
  - 9                which controls a computer to provide a mechanism to retrieve instances of
  - 10               said population which fulfil the condition stated by the filter formula of said
  - 11               filter depending on the values assigned to every filter variable of said filter;
  - 12        -        translating said validated formal language specification so as to provide code
  - 13                which controls a computer to provide a mechanism to access only part of the
  - 14               state of every instance of said population matching said condition stated by
  - 15               said filter formula of said filter, said part of said state being defined said
  - 16               display set selected in said message, said part of said state dictated by said
  - 17               display set being further constrained to the attributes said user logged onto
  - 18               said desired computer program is allowed to query;
  - 19        -        translating said validated formal language specification so as to provide code
  - 20                which controls a computer to provide a mechanism to return the instances of
  - 21               said population which fulfil said condition stated by said filter formula and, if
  - 22               an order criterion pattern has been indicated in said message, return said
  - 23               instances of said population which fulfil said condition stated by said filter
  - 24               formula in the order stated by said order criterion pattern.

1  
1       59. [New] The process of claim 45 wherein step D comprises the steps of translating  
2       said formal language specification into computer readable code which can control a  
3       computer to provide user interface interaction mechanisms which allow a user who has  
4       logged on to execute services and queries by interacting with one or more user interface  
5       interaction scenarios implemented as Service Presentation Patterns, Instance  
6       Presentation Patterns, Class Population Presentation Patterns and/or Master/Detail  
7       Presentation Patterns.

1       60. [New] The process of claim 59 wherein the steps in step D of translating said  
2       validated formal language specification to generate computer readable code which can  
3       control a computer to allow a logged on user to execute a service by interaction with a  
4       Service Presentation Pattern related to said service, said steps of translating comprising  
5       steps to generate computer readable code which implements a set of mechanisms that  
6       collaborate to construct a message for the execution of the service associated to said  
7       Service Presentation Pattern, including:

- 8       -       translating said validated formal language specification so as to provide code  
9       which controls a computer to provide a mechanism to identify said Service  
10       Presentation Pattern by its alias;
- 11       -       translating said validated formal language specification so as to provide code  
12       which controls a computer to provide a mechanism to present a help message  
13       associated with said Service Presentation Pattern to said user interacting with  
14       said Service Presentation Pattern;
- 15       -       translating said validated formal language specification so as to provide code  
16       which controls a computer to provide a mechanism to identify each argument  
17       of said service associated with said Service Presentation Pattern by the alias  
18       of each said argument of said service;
- 19       -       translating said validated formal language specification so as to provide code  
20       which controls a computer to provide a mechanism to present each argument  
21       of said service associated with said Service Presentation Pattern to said user  
22       interacting with said Service Presentation Pattern in the order and groups  
23       dictated by the Arguments Grouping Presentation Pattern (if any) associated



- 24 to said Service Presentation Pattern;
- 25 - translating said validated formal language specification so as to provide code
- 26 which controls a computer to provide a mechanism to let the user provide a
- 27 value for each argument of the service associated to said Service
- 28 Presentation Pattern
- 29 - translating said validated formal language specification so as to provide code
- 30 which controls a computer to provide a mechanism to ensure that every
- 31 argument of said service associated with said Service Presentation Pattern
- 32 that requires a value has a value and to validate that every argument that has
- 33 a value has a valid value according to every said argument data type and said
- 34 Introduction Pattern, if any, associated with every said argument;
- 35 - translating said validated formal language specification so as to provide code
- 36 which controls a computer to provide a mechanism to present the user with
- 37 the default value, if any, of every argument of said service associated to said
- 38 Service Presentation Pattern;
- 39 - translating said validated formal language specification so as to provide code
- 40 which controls a computer to provide a mechanism to access an objects
- 41 selection mechanism corresponding to a Population Selection Pattern, if any,
- 42 associated with every object valuated argument of the service associated
- 43 with said Service Presentation Pattern;
- 44 - translating said validated formal language specification so as to provide code
- 45 which controls a computer to provide a mechanism to present said user with
- 46 a help message, if any, associated to every argument of said service
- 47 associated to said Service Presentation Pattern;
- 48 - translating said validated formal language specification so as to provide code
- 49 which controls a computer to provide a mechanism to implement a
- 50 Dependency Pattern, if any, associated with every argument of the service
- 51 associated with said Service Presentation Pattern, said mechanism:
- 52 o controlling a computer to monitor the occurrence of said user interface
- 53 interaction events relevant to every said argument, which either change the
- 54 value of said argument or activate/deactivate said argument;
- 55 o controlling a computer so as to check that the condition of an Event-
- 56 Condition-Action (hereafter ECA) rule of said Dependency Pattern holds,

- 57                   and
- 58           o   executing the actions in said ECA rule of said Dependency Pattern to assign
- 59               a value and/or activate and/or deactivate other arguments of the service
- 60               associated to said Service Presentation Pattern;
- 61       -       translating said validated formal language specification so as to provide code
- 62               which controls a computer to provide a mechanism to present said user the
- 63               elements in a Display Set Pattern, if any, assigned as a Supplementary
- 64               Information Pattern to every object valuated argument of said service
- 65               associated with said Service Presentation Pattern, whenever the value of
- 66               every said argument changes;
- 67       -       translating said validated formal language specification so as to provide code
- 68               which controls a computer to provide a mechanism to allow a user to cancel
- 69               the interaction of said user with said interaction scenario represented by said
- 70               Service Presentation Pattern;
- 71       -       a mechanism to confirm and send the message which will cause the service
- 72               associated to said Service Presentation Pattern to execute.

1                   61. [New] The process of claim 59 wherein the steps in step D of translating  
2                   said validated formal language specification to generate computer readable code which  
3                   can control a computer to allow a logged on user query information on an instance of a  
4                   class, execute services on said instance and/or navigate to interaction scenarios  
5                   displaying information related with said instance, by interaction with an Instance  
6                   Presentation Pattern of the class owning said instance, said steps of translating  
7                   comprising the following steps:

- 8           -       translating said validated formal language specification so as to provide code
- 9               which controls a computer to provide a mechanism to identify said Instance
- 10           Presentation Pattern by its alias;
- 11       -       translating said validated formal language specification so as to provide code
- 12               which controls a computer to provide a mechanism to present a help
- 13               message, if any, associated with said Instance Presentation Pattern;
- 14       -       translating said validated formal language specification so as to provide code
- 15               which controls a computer to provide a mechanism to present said user with
- 16               the value of each element in the Display Set Pattern of said Instance

17 Presentation Pattern, each element identified by the alias of said element and  
18 presented in the order dictated by said Display Set Pattern, said elements  
19 being further restricted to those elements that correspond to attributes the  
20 logged on user is allowed to query;

21 - translating said validated formal language specification so as to provide code  
22 which controls a computer to provide a mechanism to access each user  
23 interface interaction scenarios corresponding to each service that can be  
24 executed on the object displayed by said Instance Presentation Pattern, each  
25 of said services identified by the alias of the Service Presentation Pattern  
26 corresponding to each of said services, said services being further restricted  
27 to the ones the logged on user is allowed to execute;

28 - translating said validated formal language specification so as to provide code  
29 which controls a computer to provide a mechanism to present said user with  
30 a help message associated with each service, if any, executable on said  
31 object displayed by said Instance Presentation Pattern;

32 - translating said validated formal language specification so as to provide code  
33 which controls a computer to provide a mechanism to access each user  
34 interface interaction scenario corresponding to each class, if any, owning  
35 instances related with the instance belonging to the class owning said  
36 Instance Presentation Pattern, each of said user interface interaction  
37 scenarios being identified by the alias of its corresponding Presentation  
38 Pattern, said user interface interaction scenarios being further restricted to  
39 the ones corresponding to classes said logged on user is allowed to query;

40 - translating said validated formal language specification so as to provide code  
41 which controls a computer to provide a mechanism to present said user with  
42 any help message associated with each of the user interface interaction  
43 scenarios corresponding to each class, if any, owning instances related with  
44 instance belonging to the class owning said Instance Presentation Pattern;  
45 and

46 - translating said validated formal language specification so as to provide code  
47 which controls a computer to provide a mechanism to cancel the interaction of  
48 the logged on user with the user interface interaction scenario represented by  
49 said Instance Presentation Pattern.

50

1       62. [New] The process of claim 59 wherein the steps in step D of translating said  
2 validated formal language specification to generate computer readable code which can  
3 control a computer to allow a logged on user to query information on a set of instances of a  
4 class, execute services on any instance in said set and or navigate to interaction scenarios  
5 displaying information related with any said instance of said set, by interaction with a Class  
6 Population Presentation Pattern of the class owning said set of instances, said steps of  
7 translating comprising the following steps:

- 8       - translating said validated formal language specification so as to provide  
9       code which controls a computer to provide a mechanism to identify said  
10      Class Population Presentation Pattern by its alias;
- 11      - translating said validated formal language specification so as to provide  
12      code which controls a computer to provide a mechanism to present any  
13      help message associated with said Class Population Presentation Pattern;
- 14      - translating said validated formal language specification so as to provide  
15      code which controls a computer to provide a set of mechanisms to obtain  
16      and display a set of instances of the class owning said Class Population  
17      Presentation Pattern, comprising:
  - 18      o a mechanism to identify the Filter Pattern, if any, associated to said Class  
19      Population Presentation Pattern;
  - 20      o a mechanism to identify and select one of the Order Criterion Patterns, if  
21      any, associated to said Class Population Presentation Pattern;
  - 22      o a mechanism to identify each Filter Variable, if any, of said Filter Pattern,  
23      if any, associated to said Class Population Presentation Pattern, said  
24      identification by the alias of each of said Filter Variables, and to present  
25      said Filter Variables to said user in the order they are defined in said  
26      Filter Pattern;
  - 27      o a mechanism to present said user a default value, if any, of each Filter  
28      Variable, if any, of said Filter Pattern, if any, associated to said Class  
29      Population Presentation Pattern;
  - 30      o a mechanism to let said user provide a value for each Filter Variable, if  
31      any, of said Filter Pattern, if any, associated to said Class Population  
32      Presentation Pattern;

- o a mechanism to validate the value assigned to each Filter Variable, if any, of said Filter Pattern, if any, associated to said Class Population Presentation Pattern, said validation carried out according to:
    - the data type of said Filter Variable;
    - what is dictated by the Introduction Pattern, if any, associated to said Filter Variable;
  - o a mechanism to access the objects selection mechanism corresponding to a Population Selection Pattern which defines the process of observing and selecting objects in a multiple objects society, said Population Selection Pattern being associated to every object valuated Filter Variable, if any, of said Filter Pattern, if any, associated to said Class Population Presentation Pattern;
  - o a mechanism to present said user with a help message, if any, associated to each Filter Variable, if any, of said Filter Pattern, if any, associated to said Class Population Presentation Pattern;
  - o a mechanism to present said user with elements in any Display Set Pattern assigned as a Supplementary Information Pattern to every object valuated Filter Variable, if any, of said Filter Pattern, if any, associated to said Class Population Presentation Pattern, whenever the value of every said Filter Variable changes;
  - o a mechanism to invoke execution of the query represented by said Filter Pattern, if any, associated with said Class Population Presentation Pattern, or to invoke the retrieval of the full population of said class owning said Class Population Presentation Pattern;
- translating said validated formal language specification so as to provide code which controls a computer to provide a mechanism to display the value of each element, for every instance in the population of the class or for every instance returned as a result of executing said query represented by said Filter Pattern, if any, associated with said Class Population Presentation Pattern, said each element being in the Display Set Pattern associated to said Class Population Presentation Pattern, said each element the value of which is displayed being restricted to those elements corresponding to attributes the logged on user is allowed to query;

- 66        -        translating said validated formal language specification so as to provide
- 67                    code which controls a computer to provide a mechanism to select one of
- 68                    the objects or instances presented to the user by said Class Population
- 69                    Presentation Pattern;
- 70        -        translating said validated formal language specification so as to provide
- 71                    code which controls a computer to provide a mechanism to, upon selection
- 72                    of one of said objects presented by said Class Population Presentation
- 73                    Pattern, access each of said user interface interaction scenarios
- 74                    corresponding to each service that can be executed on said selected
- 75                    object, each of said services identified by the alias of the Service
- 76                    Presentation Pattern corresponding to each of said services, said services
- 77                    further restricted to the services the logged on user is allowed to execute;
- 78        -        translating said validated formal language specification so as to provide
- 79                    code which controls a computer to provide a mechanism to present said
- 80                    user with any help message associated with each service executable on
- 81                    said selected object;
- 82        -        translating said validated formal language specification so as to provide
- 83                    code which controls a computer to provide a mechanism to, upon selection
- 84                    of one of said objects presented by said Class Population Presentation
- 85                    Pattern, access each of said user interface interaction scenarios
- 86                    corresponding to each class, if any, owning instances related with said
- 87                    selected object of said class owning said Class Population Presentation
- 88                    Pattern, each of said user interface interaction scenarios being identified by
- 89                    the alias of its corresponding Presentation Pattern, said user interface
- 90                    interaction scenarios being further restricted to the ones corresponding to
- 91                    classes said logged on user is allowed to query;
- 92        -        translating said validated formal language specification so as to provide
- 93                    code which controls a computer to provide a mechanism to present said
- 94                    user any help message associated with each of said user interface
- 95                    interaction scenarios corresponding to each class, if any, owning
- 96                    instances related with said selected object of said class owning said Class
- 97                    Population Presentation Pattern; and
- 98        -        translating said validated formal language specification so as to provide

99 code which controls a computer to provide a mechanism to cancel the  
 100 interaction of the logged on user with the interface interaction scenario  
 101 represented by said Class Population Presentation Pattern.

1 63. [NEW] The process of claim 59 wherein the steps in step D of translating said  
 2 validated formal language specification to generate computer readable code which can  
 3 control a computer to allow a logged on user to interact with an interaction scenario  
 4 corresponding to a Master/Detail Presentation pattern so as to query information on:  
 5 - instances belonging to the class owning said Master/Detail Presentation  
 6 Pattern as presented in a Presentation Pattern referred to as a Master  
 7 Presentation Pattern, which is either an Instance Presentation Pattern or a  
 8 Class Population Presentation Pattern owned by the same class owning  
 9 said Master/Detail Presentation Pattern, and  
 10 - instances belonging to other classes related to said class owning said  
 11 Master/Detail Presentation Pattern, each set of related instances as  
 12 presented by a Presentation Pattern referred to as Detail Presentation  
 13 Pattern, which is either an Instance Presentation Pattern, or a Class  
 14 Population Presentation Pattern, or belonging to a Master/Detail Presentation  
 15 Pattern owned by said class related with said class owning said Master  
 16 Presentation Pattern,  
 17 said steps of translating comprising the steps of:  
 18 - translating said validated formal language specification so as to provide  
 19 code which controls a computer to provide a mechanism to identify said  
 20 Master/Detail Population Presentation Pattern by its alias;  
 21 - translating said validated formal language specification so as to provide  
 22 code which controls a computer to provide a mechanism to present said  
 23 user any help message associated with said Master/Detail Presentation  
 24 Pattern;  
 25 - translating said validated formal language specification so as to provide  
 26 code which controls a computer to provide a mechanism to present said  
 27 user the Master Presentation Pattern of said Master/Detail Presentation  
 28 Pattern;  
 29 - translating said validated formal language specification so as to provide



30 code which controls a computer to provide a mechanism to present said  
31 user with every Detail Presentation Pattern of said Master/Detail  
32 Presentation Pattern;  
33 - translating said validated formal language specification so as to provide  
34 code which controls a computer to provide a mechanism to synchronize  
35 information displayed in every Detail Presentation Pattern whenever:  
36 o the object displayed in the Master Presentation Pattern changes, or  
37 o the selection of one of the objects displayed in the Master Presentation  
38 Pattern changes  
39 - translating said validated formal language specification so as to provide  
40 code which controls a computer to provide a mechanism to cancel the  
41 interaction of the logged on user with the interaction scenario represented  
42 by said Master/Detail Presentation Pattern.  
43  
44



code which controls a computer to provide a mechanism to present said user with every Detail Presentation Pattern of said Master/Detail Presentation Pattern;

- translating said validated formal language specification so as to provide code which controls a computer to provide a mechanism to synchronize information displayed in every Detail Presentation Pattern whenever:
  - o the object displayed in the Master Presentation Pattern changes, or
  - o the selection of one of the objects displayed in the Master Presentation Pattern changes
- translating said validated formal language specification so as to provide code which controls a computer to provide a mechanism to cancel the interaction of the logged on user with the interaction scenario represented by said Master/Detail Presentation Pattern.

Respectfully submitted,

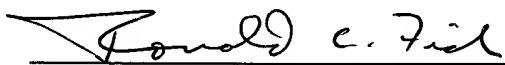


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